Appendix 1. Buffalo concussion physical exam instrument

Buffalo Concussion Physical Exam Instrument

Vital Signs	Standard	0 minutes	1 minute	3 minutes
Position	Seated	Supine	Standing	Standing
Blood Pressure	____/____	____/____	____/____	____/____
Heart Rate	_____	_____	_____	_____
Symptoms Increased?			Y or N	Y or N
Test results positive if: SBP ↓20 or DBP ↓10 (and Symptoms worsen)			+ or -	+ or -

Cognitive Assessment	
Orientation	____/5
Immediate Memory	____/15
Concentration	____/5
Delayed Recall	____/5
Total Score	____/30

Mental Status		
Mood		☐Angry ☐Apathetic ☐Dysphoric ☐Labile ☐_____
Affect		☐Incongruent ☐Blunted ☐_____
Insight		☐Limited ☐Poor ☐_____
Judge-		☐Limited ☐Poor ☐_____

PHQ-9 Score	Depression Severity
0-4	None-minimal
5-9	Mild
≥10	Moderate to severe

Cranial Nerves*			
CN	Suggested Test	Nml	Abn
I Olfactory	Smell coffee grounds		
V Trigeminal	Open mouth; Facial sensation		
VII Facial	Smile, puff cheeks, wrinkle		
IX Glossophar.	Palatal elevation		
X Vagus	Swallow		
XII Hypoglossal	Tongue strength (against cheek)		
*CN II, III, IV, VI, VIII, and XI elsewhere tested			

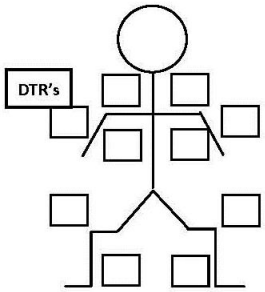
Postural control / motor coordination		
Test	Nml	Abn
Finger-Nose		
Modified BESS		
Tandem gait		

Head	Nml	Abn
Cranium		☐Swelling ☐Depression ☐Hemotympanum ☐_____
TMJ		☐Tender ☐ Popping ☐_____
Other		☐_____
Neck	**Nml**	**Abn**
Spasm		☐Right ☐Left ☐_____
Tenderness		☐Right ☐Left ☐_____
Spurlings		☐Right ☐Left ☐_____
Cervical ROM (nml)	**Nml**	**Abn**
Flexion (50°)		
Extension (60°)		
Rt lat flexion (45°)		
Lt lat flexion (45°)		
Rt rotation (80°)		
Lt rotation (80°)		
Proprioception		☐Right ☐Left ☐_____
Other		☐_____
Thoracic	**Nml**	**Abn**
Kypho-scoliosis		☐↑ Kyphosis ☐Scoliosis ☐_____
Spasm		☐Right ☐Left ☐_____
Scapular Dyskinesia		☐Right ☐Left ☐_____
Other		☐_____

Manual Muscle Testing (__/5)		
Muscle/action (innervation)	Right	Left
Sh. shrug (CN XI)		
Deltoid (C5)		
Biceps (C5-6)		
Wrist ext. (C6-7)		
Grip (C8)		
Finger abd. (T1)		
Hip flexion (L2-3)		
Quadriceps (L3-4)		
Ankle DF (L4-5)		
Ankle PF (L5-S1)		
Ext. Hall. Long. (L5)		

Optic/Ophthalmologic Evaluation		
Suggested Test	Nml	Abn
Visual Fields (CN III, IV, VI)		
Smooth Pursuits		
Accomodation		
Nystagmus		
Saccades		
Vestibulo-Ocular Reflex * (CN VIII)		
Visual Acuity (CN II)		
Fundoscopy		
Pupil reactivity		

*If VOR is positive, or with patient reported symptom of dizziness, add the following vestibular system evaluation		
Test	Nml	Abn
Otoscopic Exam		
Dix-Halpike		
Dynamic Visual Acuity		



	Right		Left	
*UMN sign	Abs	+	Abs	+
Babinski				
Hoffman				
Pron. Drift				
* For upper motor neuron conditions, an absent finding is the normal condition				

Detailed Instructions for isolated elements of the Buffalo Concussion Physical Exam Instrument.

This instrument outlines a toolbox of physical examination elements across several domains commonly affected by concussion that are practical and based on the best available evidence.

Some examination elements (eg, orthostatic vital signs) can be tasked to ancillary staff to help with efficiency. A skilled physician should be able to complete the exam in less than 10 minutes.

I) Orthostatic vital signs, when indicated[16]

a. Patient lies down for 2 minutes. Document blood pressure (BP) and heart rate (HR).

b. Have the patient stand. Wait 1 minute and document BP and HR.

c. Wait 2 more minutes with patient standing and document BP and HR.

d. A positive test is defined as a decrease in systolic BP by at least 20 mm Hg or a decrease in diastolic BP by 10 mm Hg, if either is associated with symptoms.

e. If a HR change of 20 bpm accompanies the changes in BP, it is more likely to be a hypolvolemic response, whereas an absence of an HR response can indicate a neurogenic cause.

f. Also consider POTS if tachycardia without blood pressure change is accompanied by symptoms.

II) Cognitive Assessment[63]

a. Orientation (5 points)

i. 1 point given for each orientation question, including month, date, day, year, and time.

b. Immediate memory (15 points): 5 item recall

i. Recite a list of 5 unrelated items. Ask the patient to repeat as many items back as they can remember, in any order. This should be completed 3 times in succession. 1 point awarded for each item in each trial.

c. Concentration (5 points)

i. Reverse digit recall: Recite a string of digits and ask the patient to repeat the string in **reverse** order. Start with a string of 3 numbers and increase by 1 digit in each trial. Complete 4 trials (up to a 6-digit sequence). 1 point is awarded for each correct reverse sequence.

ii. Months in reverse: Have the patient start from the current month and recite the names of the months in reverse order until they return to the starting month. 1 point is awarded for completing this task correctly.

d. Delayed recall (5 points)

i. Ask the patient to repeat the previous list of 5 unrelated items.

e. Total score

i. Add total points from each of the sections.

III) PHQ-9[53]

a. Patient completes questionnaire when clinically indicated. Score as indicated on the PHQ-9 instrument. The following table may be referenced for treatment

considerations.

PHQ-9 Score	Depression Severity	Proposed Treatment Actions
0 – 4	None-minimal	None
5 – 9	Mild	Watchful waiting; repeat PHQ-9 at follow-up
10 – 14	Moderate	Treatment plan, considering counseling, follow-up and/or pharmacotherapy
15 – 19	Moderately Severe	Active treatment with pharmacotherapy and/or psychotherapy
20 – 27	Severe	Immediate initiation of pharmacotherapy and, if severe impairment or poor response to therapy, expedited referral to a mental health specialist for psychotherapy and/or collaborative management

b. Examiners should use their clinical acumen to determine mood, affect, insight, and judgment and whether specific treatment for affective disorders is indicated.

IV) Examination

a. Cervical proprioception[5]

i. This test is performed with the patient in a seated position. Have the patient focus on an object with their head in neutral position and then close their eyes. The subject rotates their head to one side and then returns their head to neutral position while keeping their eyes closed. An abnormal result is greater than 5 degrees from the target. *Please note that when performed in this fashion without the validated tools (initial and validation studies have used a laser pointer head apparatus and wall target), the results are nondiagnostic.

b. Scapular winging[61]

i. Note is made that this is assessed in both flexion and abduction planes

V) Optic/ophthalmologic

a. Smooth pursuits[11]

i. The patient is asked to visually track an object moving slowly in horizontal and vertical directions (20 degrees/s) while keeping his head stationary. Target movement should be limited to 30 degrees from neutral to avoid eliciting end-gaze nystagmus.

ii. Examiner observes for conjugate vision, corrective (catch-up or back-up) saccades, loss of visual fixation, or increased symptoms (ie, dizzy/nausea/headache).

b. Accommodation and convergence[77]

i. The near point of convergence can be determined by holding a target object, such as a penlight or a letter, on a handheld Snellen chart (20/30 line), about 20 to 25 cm centered in front of the subject's eyes. The target is then moved toward the subject at a rate of about 1 to 2 cm/s. Record the distance at which diplopia occurs. Normal is 6 to 10 cm.

ii. This is performed with each eye and then with both eyes

c. Gaze-holding nystagmus[11]

i. Check for nystagmus by examining the eyes in the 9 positions (upper, middle, and lower left, center, and right). The patient is then asked to track a finger to 30 degrees of ocular motion in all planes of vision. Examiner observes for sustained nystagmus or loss of fixation. Abnormal responses include any loss of fixation at less than 30 degrees of ocular range in horizontal or vertical planes.

d. Saccades[11]

i. The patient is asked to glance back and forth between 2 horizontal or 2 vertical targets, such as 2 widely spaced index fingers. The velocity, accuracy, and the conjugacy of the saccades should be noted. Normal individuals can immediately reach the target with a fast single movement or 1 small corrective saccade. Abnormal responses include delayed initiation of eye movement, slow velocity, or inaccurate movements including over/undershooting (hyper/hypometric motions) with greater than 2 refixation saccades. This may be accompanied by symptoms.

e. Vestibulo-ocular reflex -head-impulse, head thrust, or Halmagyi test[11]

i. To test the horizontal VOR, the examiner holds the patient's head between both hands, asks him to fixate on the examiner's nose, and rapidly and arbitrarily turns the patient's head horizontally to the left and then to the right. This rotation of the head in a healthy subject causes rapid compensatory eye movements in the opposite direction. The examiner observes for loss of fixation from his or her nose.

VI) Vestibular

a. Dynamic visual acuity[11]

i. The examiner turns the subject's head horizontally to the right and left with a frequency of about 2 Hz and visual acuity is determined by Snellen chart. A decrease of baseline visual acuity by at least 3 lines is pathological.

VII) Postural control/motor coordination

a. Modified BESS[38,44]

    i. Standing on a firm surface with (a) double-leg, (b) single (nondominant) leg (hip is flexed to approximately 30 degrees and knee flexed to approximately 45 degrees), and (c) tandem stances. Hands are on the hips and eyes closed. The subject is to try to maintain stability for 20 seconds with eyes closed. Errors are counted including: (1) hands lifted off iliac crest; (2) opening eyes; (3) step, stumble, or fall; (4) moving into >30 degrees hip abduction; (5) lifting forefoot or heel; (6) remaining out of test position >5 seconds. NOTE: Subjects who are unable to maintain the testing procedure for a minimum of 5 seconds are assigned the highest possible score (10) for that testing condition.

    ii. - Abnormal response includes 5 or more errors during each 20-second trial.

b. Heel-to-toe tandem gait[78,79]

    i. The patient is asked to walk 10 feet with a heel-to-toe gait. An abnormal test includes falling, grabbing an object, or moving excessively slow.